Report No. UT-06.15a.

GOOD ROADS COST LESS
2006 Study Update

Executive Summary

Prepared For:

Utah Department of Transportation Research and Development Division

Submitted By:

Deighton Associates Limited
112 King Street East
Bowmanville, Ontario, Canada
L1C 1N5

Authored By:

Jeffrey L. Zavitski, Deighton Associates Limited
Kim Schvaneveldt, Utah Department of Transportation
Austin Baysinger, Utah Department of Transportation
Abdul Wakil, Utah Department of Transportation
Bill Lawrence, Utah Department of Transportation
Dave Blake, Utah Department of Transportation
Doug Anderson, Utah Department of Transportation
Gary Kuhl, Utah Department of Transportation
Glen Ames, Utah Department of Transportation
Lloyd Neeley, Utah Department of Transportation

December 2006

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
UT-06.15		

4. Title and Subtitle	5. Report Date
GOOD ROADS COST LESS 2006 Study Update	December 2006
	6. Performing Organization Code

7. Author	8. Performing Organization Report No.
Jeffrey L. Zavitski, Kim Schvaneveldt Austin Baysinger, Abdul Wakil, Bill Lawrence, Dave Blake, Doug Anderson, Gary Kuhl, Glen Ames, Lloyd Neeley	

9. Performing Organization Name and Address	10. Work Unit No.
Deighton Associates Limited 112 King Street East, Bowmanville, Ontario, Canada, L1C 1N5	11. Contract or Grant No. 069015

12. Sponsoring Agency Name and Address	13.Type of Report & Period Covered
Utah Department of Transportation 4501 South 2700 West Salt Lake City, Utah 84114-8410	Final Version
	14. Sponsoring Agency Code Job Number:81 SR 0640

15. Supplementary Notes

Prepared in cooperation with the Utah Department of Transportation and the Federal Highway Administration

16. Abstract

In October of 1977, The Utah Department of Transportation (UDOT) published the results of a research study entitled “Good Roads Cost Less: Pavement Rehabilitation Needs, Benefits and Costs in Utah.” The Good Roads Cost Less study was revolutionary when published and it is still referred to today as an excellent study to explain the need for maintaining pavements and infrastructure assets in good condition.

Almost thirty years later UDOT continues to face challenges maintaining pavements in good condition within the context of a constrained budget environment. This report presents an update to the original Good Roads Cost Less study and takes into account additional factors and data that were unavailable when the first study was undertaken. The report reaffirms that Good Roads do indeed Cost Less for the State of Utah and anyone traveling along the UDOT Highway network.

17. Key Words	18. Distribution Statement	23. Registrant's Seal
Asset Management, Pavement Management, Optimization, Performance Measures, RSL, Life Cycle Costing,	UDOT Research Division 4501 south 2700 West-box 148410 Salt Lake City, Utah 84114	

19. Security Classification	20. Security Classification	21. No. of Pages	22. Price
Unclassified	Unclassified	27	

DISCLAIMER

The Contents of this report reflect the view of the authors, who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Utah Department of Transportation (UDOT).

Table of Contents

List of Figures

List of Tables

1. Executive Summary

This report presents an update to the original Good Roads Cost Less study undertaken in 1977. The report reaffirms that Good Roads do indeed Cost Less for the State of Utah and anyone traveling along the UDOT Highway network.

The Good Roads Cost Less study was revolutionary when published and it is still referred to today as an excellent study to explain the need for maintaining pavements and infrastructure assets in good condition.

This report updates the original study and includes new performance measures and analysis methodologies that were not available when the original study was published.

1.1 Transportation within Utah

In the years since the original study was published, population growth and transportation demand have stretched and strained the transportation network to the fullest. During this same time period, the nation's infrastructure capacity has not kept up with the increase in demand for transportation. Along with the increase in travel demand and the lack of adequate new facilities to accommodate the increased demand, the infrastructure across the nation is aging and requires increased levels of preservation and rehabilitation expenditures to maintain the network in an acceptable condition.

Travel demand expressed in vehicle miles traveled across the United States during the years from 1980 to 2001 increased over 82% as follows[1]:

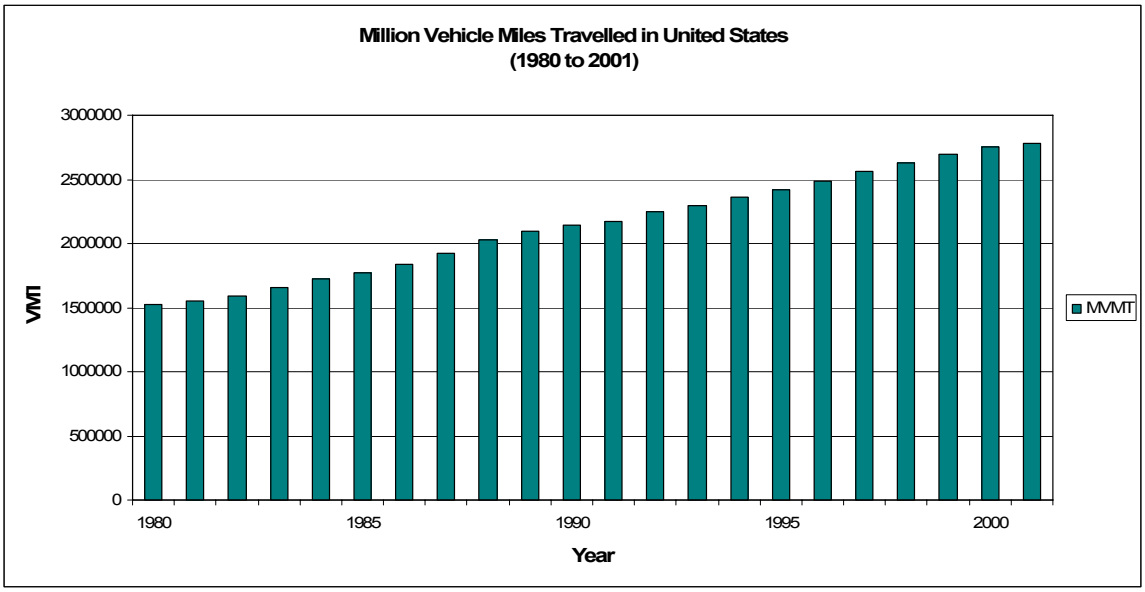

Figure 1: United States Travel Demand 1980 - 2001

When the historical state highway system is investigated over the last decade, the growth in the total state network mileage has only seen an increase of approximately 53 (center line) miles while the traffic traveling over those roadways has increased tremendously. In simple terms, the use of the state highway network has increased significantly but the size of the network has remained virtually the same.

The total roadway transportation network in Utah is comprised of the following roadway systems and associated vehicle miles traveled (VMT)[2]. VMT is calculated by multiplying the length of the network by the total amount of vehicles using that network in one year.

Roadway Classification	Total Mileage	Annual VMT	% of Total VMT
State Highway System	**5,846**	**17,080,351,939**	**69.31%**
County Road System	23,637	2,056,303,078	8.34%
City Street Network	9,215	5,421,705,255	22.00%
Forest Service Roads	2,327	83,297,819	0.34%
National Park Service	685		
Native American	723		
Other Federal Agencies	271		
Total	**42,704**	**24,641,658,091**	**100%**

Table 1: Annual Vehicle Miles Traveled (2004)

Approximately one third (8.9 billion) of the annual VMT (24.6 billion) takes place on the Interstate system with approximately two thirds of that VMT taking place on urban interstates and one third of that VMT taking place on rural interstates. The annual VMT figures displayed in table 1 underscores the crucial importance of the Utah highway network and the need to maintain the facilities in an operable condition.

1.2 The Challenge to UDOT

UDOT must find an effective funding balance between system expansion to handle the increased demand and the need to maintain the existing network in good condition. In order to achieve the understanding necessary to begin to balance the funding between expansion and preservation, it was first necessary to determine the effects of different preservation and rehabilitation strategies on the Utah highway network. That need led to this update of the Good Roads Cost Less Study.

1.3 The Good Roads Cost Less Study Update

UDOT has established systematic processes for maintaining the different state highway network classifications at various levels of performance. The authors of this study determined the impacts of different performance targets on the network and the users of the highway network.

Deighton and UDOT configured UDOT's dTIMS CT Pavement Management System (PMS) to analyze many different alternative strategies for maintaining and rehabilitating the UDOT highway network over a 20 year analysis period. The goal of the study was to determine the effects of different policies on the study analysis variables and to determine target condition levels for maintaining the UDOT pavement network.

1.4 The Good Roads Cost Less Study Analysis Variables

This study investigated the performance targets for the various highway functional classifications within Utah and validated their effectiveness in terms of pavement condition and other significant factors as outlined below:

Agency Costs: Maintaining the state highway network at any performance target has a cost associated with it. This part of the study determined the various costs associated with maintaining the network at various condition levels.

User Costs: The users of the highway network incur an annual cost for traveling the network in terms of fuel costs, wear and tear on the vehicle and wear and tear on the tires. The cost to the user increases depending on the condition of the roadway. The study investigated user costs within Utah and developed a relationship between pavement condition and performance targets and the user costs incurred by the traveling public.

Safety: Maintaining the highway network in good condition contributes to lower accident rates across the state. The study investigated accident rates related to pavement condition to develop a relationship between the two and how safety impacts the performance targets.

Delay Costs: Delay costs may seem slight when one individual vehicle is examined but when the delay of all vehicles are taken into consideration the delay costs to the traveling public are quite substantial. When UDOT performs preservation and rehabilitation projects on the highway network, delay costs are introduced to the traveling public through detours and congestion. These delay costs have an impact on the timing of preservation and rehabilitation projects as well as system expansion projects.

By examining these relationships and including them in the decision making processes within UDOT, UDOT has a greater understanding of the effects of funding allocation decisions between preservation and system expansion on the performance of the state highway system.

1.5 The Good Roads Cost Less Study Analysis

The alternative strategies investigated by UDOT and Deighton are described in the following table and then a brief description of the scenario follows.

Strategy Number	Strategy Name
01	Do Nothing
02	Maintenance Only
03	Reconstruction Only
04	Current Model - No Budget Categories
04	Current Model – With Budget Categories
05	Cycle 6 Years and 10 Years - No Budget Categories
05	Cycle 6 Years and 10 Years – With Budget Categories
06	Cycle 6 Years and 12 Years - No Budget Categories
06	Cycle 6 Years and 12 Years – With Budget Categories
07	Cycle 8 Years and 10 Years - No Budget Categories
07	Cycle 8 Years and 10 Years – With Budget Categories
08	Cycle 8 Years and 12 Years - No Budget Categories
08	Cycle 8 Years and 12 Years – With Budget Categories
09	Cycle 10 Years and 10 Years - No Budget Categories
09	Cycle 10 Years and 10 Years – With Budget Categories
10	Condition 10% Less - No Budget Categories
10	Condition 10% Less – With Budget Categories

11	Condition 20% Less - No Budget Categories
11	Condition 20% Less – With Budget Categories
12	No Funding Five Years - No Budget Categories
12	No Funding Five Years – With Budget Categories
13	50% Funding Five Years - No Budget Categories
13	50% Funding Five Years – With Budget Categories

Table 2: Alternative Strategies

Within the dTIMS CT Pavement Management System, the optimization functionality allows the users to choose if they want the optimization to spend the available funding according to the established Budget Categories or without regard to the Budget Categories. In Table 2, the "With Budget Categories" and "No Budget Categories" designation indicates if the Budget Categories were used or not.

If No Budget Categories (NBC) were used within the strategy, dTIMS CT could spend the annual budget without respect to any categories or pots of money. If mathematically optimal, dTIMS CT could spend 100% of the funding on rehabilitation treatments (Blue Book Projects) or 100% of the funding on minor maintenance and preservation treatments (Orange Book Projects). When the strategy was implement With Budget Categories (WBC), the optimization was restricted to using dedicated Blue Book and Orange Book funding amounts without the ability to switch funds between the different budget categories.

The results for the analysis runs were completed and reported using a budget amount of $180 million per year increasing at 3% per year. The total amount of available funding for the $180 million dollar analysis is outlined in the following table:

Alternative Strategy Total Available Budgets	**Total**	**Blue Book Program**	Orange Book Program
No Categories Budget Amount	$4,836,667,408	n/a	**n/a**
Categories Budget Amount	**$4,836,667,408**	**$3,224,444,939**	**$1,612,222,469**

Table 3: Budget Distributions for $180 million scenario

1.5.1 Strategy 01 – Do Nothing

The Do-Nothing strategy was included to demonstrate the deterioration of the highway network and how quickly the highway network pavements deteriorate over time and how quickly the condition of the pavements deteriorates to poor condition. The Do Nothing strategy, though unrealistic for UDOT, demonstrates the tremendous increase in user costs and accident costs when the roughness (RIDE) and friction (SKID) deteriorate.

1.5.2 Strategy 02 – Maintenance Only

The Maintenance Only strategy was included within the analysis to demonstrate the affects on the network if all rehabilitation treatments were removed from the analysis and the routine maintenance program was responsible for maintaining the network in its current condition.

1.5.3 Strategy 03 – Reconstruction Only

The Reconstruction Only strategy was included within the analysis to demonstrate the affects on the network if UDOT adopted a "worst fist" type of programming. Worst First allows the highway network to deteriorate and incorporates reconstruction as the only alternative when the pavements get to poor condition.

1.5.4 Strategy 04 – UDOT Current Model

Strategy 04 represents the current UDOT dTIMS CT Pavement Management System with no changes and serves as the base model. Within the UDOT current model, asphalt treatments have an 8 year treatment timing cycle for both maintenance and rehabilitation type treatments and concrete has a 15 year cycle for any treatment. What this means within the analysis is that a segment receiving an initial treatment will not

generate a subsequent treatment for at least 8 years for asphalt pavements and 15 years for concrete pavements.

1.5.5 Strategy 05 – Cycle 6 Years and 10 Years

Strategy 05 modified the UDOT base model and changed the treatment timing cycle to be 6 years for any maintenance treatments and 10 years for any rehabilitation treatments.

1.5.6 Strategy 06 – Cycle 6 Years and 12 Years

Strategy 06 modified the UDOT base model and changed the treatment timing cycle to be 6 years for any maintenance treatments and 12 years for any rehabilitation treatments.

1.5.7 Strategy 07 – Cycle 8 Years and 10 Years

Strategy 07 modified the UDOT base model and changed the treatment timing cycle to be 8 years for any maintenance treatments and 10 years for any rehabilitation treatments.

1.5.8 Strategy 08 – Cycle 8 Years and 12 Years

Strategy 08 modified the UDOT base model and changed the treatment timing cycle to be 8 years for any maintenance treatments and 12 years for any rehabilitation treatments.

1.5.9 Strategy 09 – Cycle 10 Years and 10 Years

Strategy 09 modified the UDOT base model and changed the treatment timing cycle to be 10 years for any maintenance treatments and 10 years for any rehabilitation treatments.

1.5.10 Strategy 10 – Condition 10% Less

Strategy 10 modified the UDOT base model and decreased the condition of every road section within the road network by 10%. This strategy was included to demonstrate what would happen to funding needs if the network was not in as good of a condition as it is today.

1.5.11 Strategy 11 – Condition 20% Less

Strategy 11 modified the UDOT base model and decreased the condition of every road section within the network by 20%. This strategy was included to demonstrate what would happen to funding needs if the network was not in as good of a condition as it is today.

1.5.12 Strategy 12 – No Funding for 5 Years

Strategy 12 modified the UDOT base model and allowed for 0 funding for the first 5 years of the analysis. This strategy was included to demonstrate what would happen to funding needs if the pavement maintenance and rehabilitation funding was cut altogether to supplement other assets or capacity improvements.

1.5.13 Strategy 13 – 50% Funding for 5 Years

Strategy 13 modified the UDOT base model and allowed for 50% funding for the first 5 years of the analysis. This strategy was included to demonstrate what would happen to funding needs if the pavement maintenance and rehabilitation funding was cut to 50% of normal levels in order to supplement other assets or capacity improvements.

1.6 The Good Roads Cost Less Study Analysis Results

Deighton and UDOT Summarized the analysis results for each strategy using and used summary charts and graphics to examine the effects of the strategies on each performance measure.

1.6.1 Agency Costs – The Costs to UDOT to Maintain the Network

Within each alternative strategy analysis, each optimization set was given the same budget amounts either as a total figure (no budget categories) or split into two different budget categories (the Orange Book minor maintenance and preservation category and the Blue Book rehabilitation and reconstruction category). The total 20 year analysis budget available was as follows:

Strategy	Total Available	Blue Book	Blue Book
No Budget Categories	$4,836,667,408	n/a	n/a
With Budget Categories	$4,836,667,408	$3,224,444,939	$1,612,222,469

Table 4: Optimization Budget Amounts

Strategy 12 and Strategy 13 had reduced funding in the initial 5 years of the analysis so the total available budget for those two analyses was slightly less.

The total agency cost of each strategy is outlined in **Figure 2** as follows:

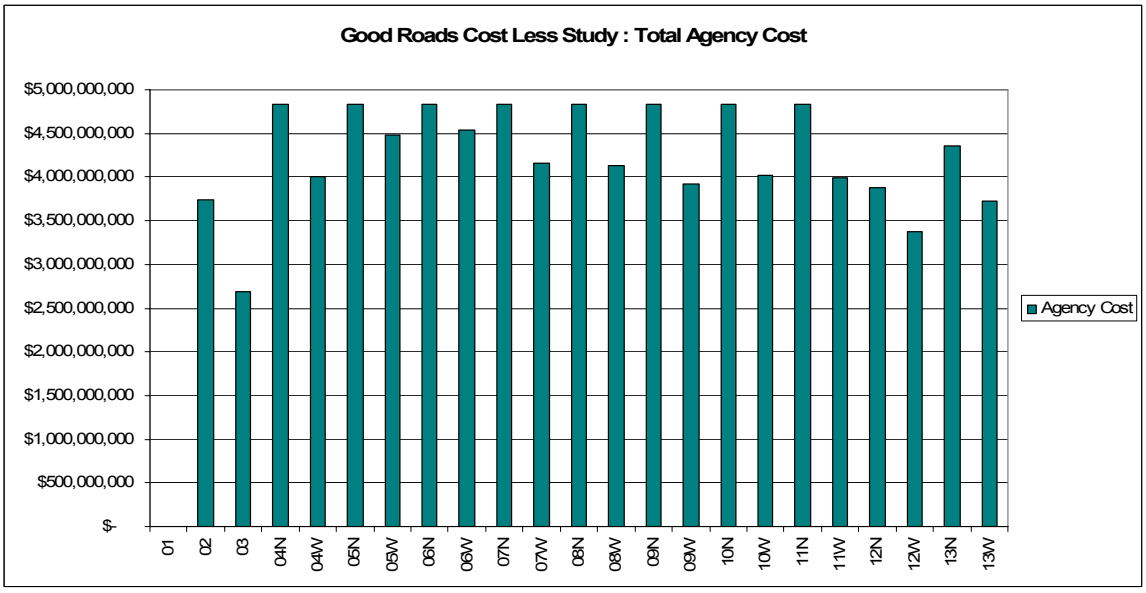

Figure 2: Total Agency Cost by Strategy

One thing that is evident immediately when looking at the Total Agency Costs is that the analysis consistently spent the entire budget amount in strategies where budget categories were not used. The strategies where the budget categories are used consistently do not spend the entire available budget and in some instances a surplus of $800 million goes unspent on the highway network. This surplus of funds is caused by timing of the maintenance and minor preservation treatments as well as the trigger mechanisms for these treatments which need to be investigated within the PMS model.

When the Agency Costs are presented in terms of Budget Categories, the source of the shortfall in expenditure becomes evident as shown in Figure 3.

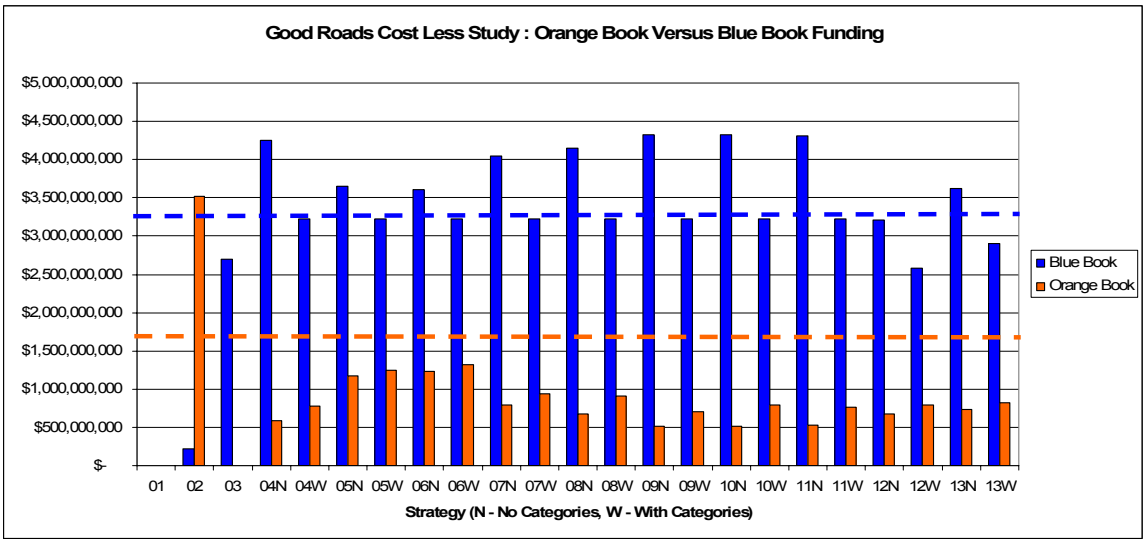

Figure 3: Orange Book versus Blue Book Funding

Orange book expenditures consistently fall below the available budget in the strategies where budget categories are used while the Blue book budget category consistently reaches full expenditure. When the maintenance cycle is shortened (Strategy 5 and Strategy 6) the Orange book expenditure is the greatest and a more thorough study of the timing cycle of Orange book treatments will be one of the recommendations of this study.

1.6.2 User Costs

The analysis has demonstrated that user costs within the network are increasing and will no doubt be a concern for motorists in the future. It is important to note here, that the user cost figures quoted in the report refer to the total user operating cost, not just the additional cost due to increased roughness. The User Costs range from a low of $229 billion to a high of $244 billion as shown in **Error! Reference source not found.**.

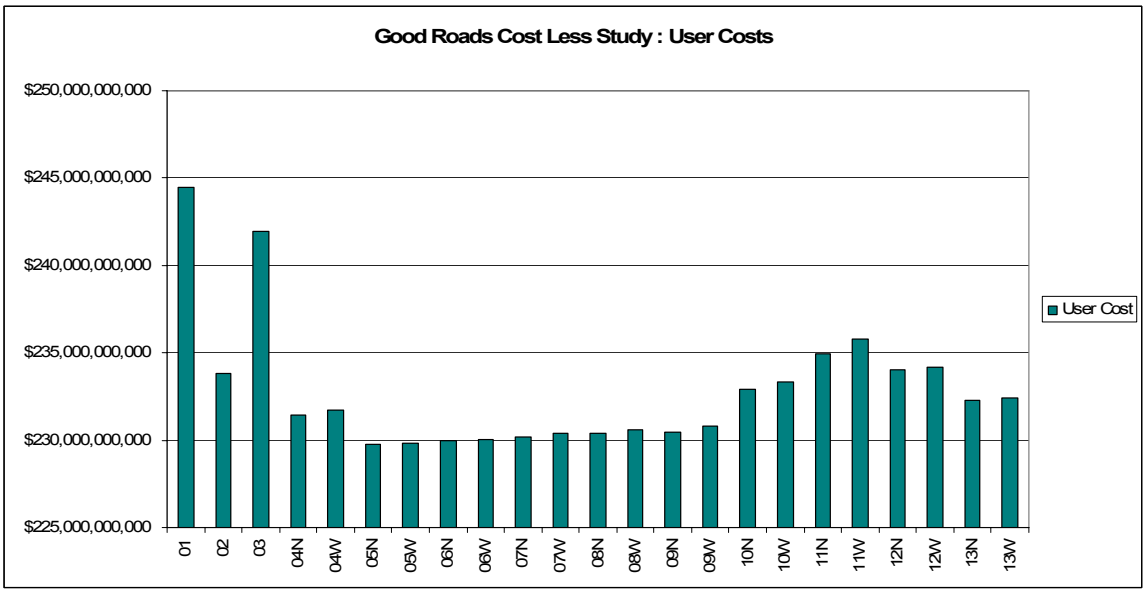

Figure 4: User Costs for By Strategy

It is important to note that the traffic level, percent trucks and user costs calculations are consistent within each of the strategies. The only variable that changed from strategy to strategy was the Ride Index which plays a role in the calculation of user costs.

What can be witnessed from the analysis results from Strategies 4 through 9 is that the user costs are relatively consistent around the $230 billion dollar level. This is related to the fact that the traffic is consistent through all of the strategies and each strategy keeps the Ride Index approximately the same throughout the analysis. The only large scale change in users costs come when the condition of the network deteriorates greatly (Strategies 1,2,3, 10N, 10W, 11N, 11W) and when the funding is reduced (Strategies 12N, 12W, 13N and 13W).

This evidence is further supported by the next figure which presents the user costs along with the Ride index variable in year 20 of the analysis.

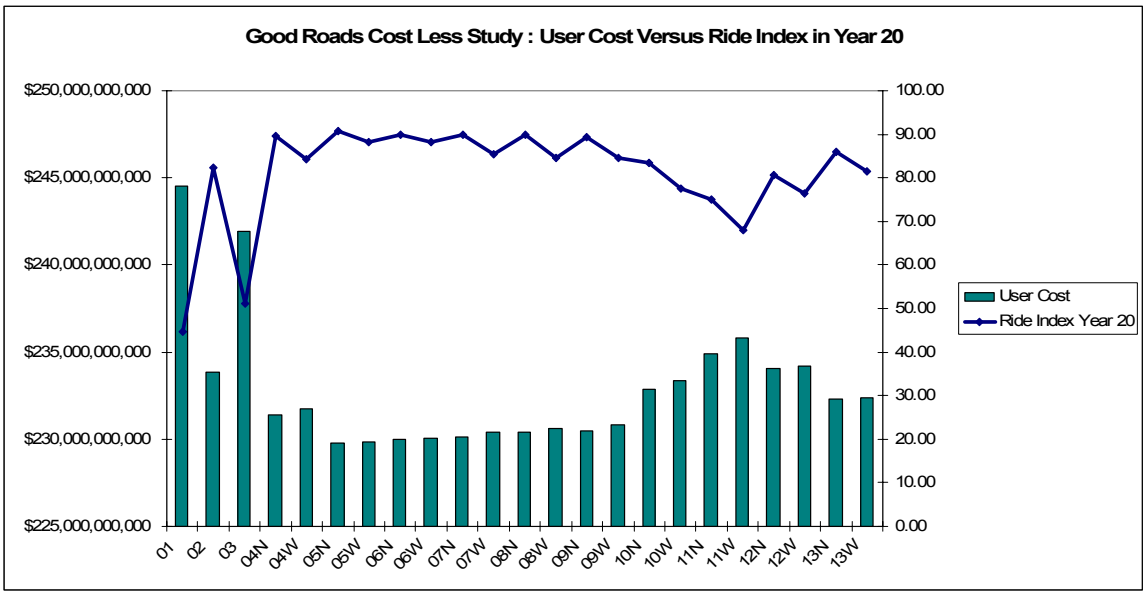

Figure 5: User Cost versus Ride Index

As far as user costs are concerned, a smooth ride helps reduce the total vehicle operating costs over the life of the analysis. But, a significant change in the Ride Index does not necessarily increase or decrease the user costs significantly. When the Ride index is reduced by 10% the User Costs increase by less than 1% and when the Ride Index is reduced by 20%, the User Costs increase by only 1.5%. The overall user costs for the UDOT highway network are increasing dramatically for each scenario because the traffic levels across the highway network are increasing yearly. Within the analysis, an average annual growth rate of 5% was applied to the traffic volume for each pavement section, which causes the vehicle operating costs to increase significantly within each of the analyses completed for the study.

1.6.3 Accidents Costs

Much like User Costs and the Ride Index, Accident Costs within the analysis vary primarily based on the values of the Skid Number as the other variables are constant throughout each strategy.

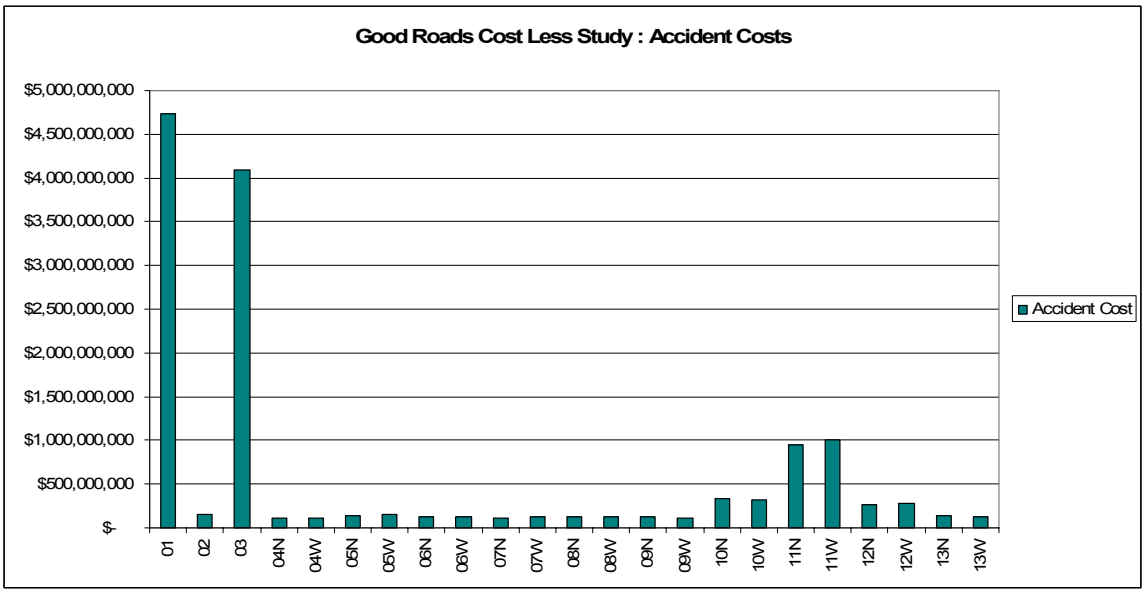

Figure 6: Accident Costs by Strategy

The increased Accident Costs based entirely on the Skid Number do not really play a factor in the analysis for strategies 4 through 9 (maximum of $159 million), but when funding is significantly reduced or the conditions of the network allowed to deteriorate into a fair and even a poor condition, the accident costs based on the deteriorating skid numbers increase quite quickly. The UDOT highway network is in good condition and in the case of accident costs, good roads do cost less.

These Accident costs are different and much lower than agency costs and user costs for the following reasons:

- Accident Costs are a "delta cost" which reflects only change in cost between increased accident rates due to low skid numbers and not the total cost of all accidents occurring on UDOT Highways;

- Not all safety related costs are included within the accident cost figures: costs due to roughness, rutting, potholes, edge drop offs and other factors are not included within the cost figures;

- Costs to society and to UDOT due to lawsuits between parties involved in the accident take funds away from other important department activities and are not taken into consideration.

1.6.4 Delay Costs

Delay costs give an indication as to which strategies impact the public the most through the delay caused by implementing the recommended maintenance and rehabilitation projects.

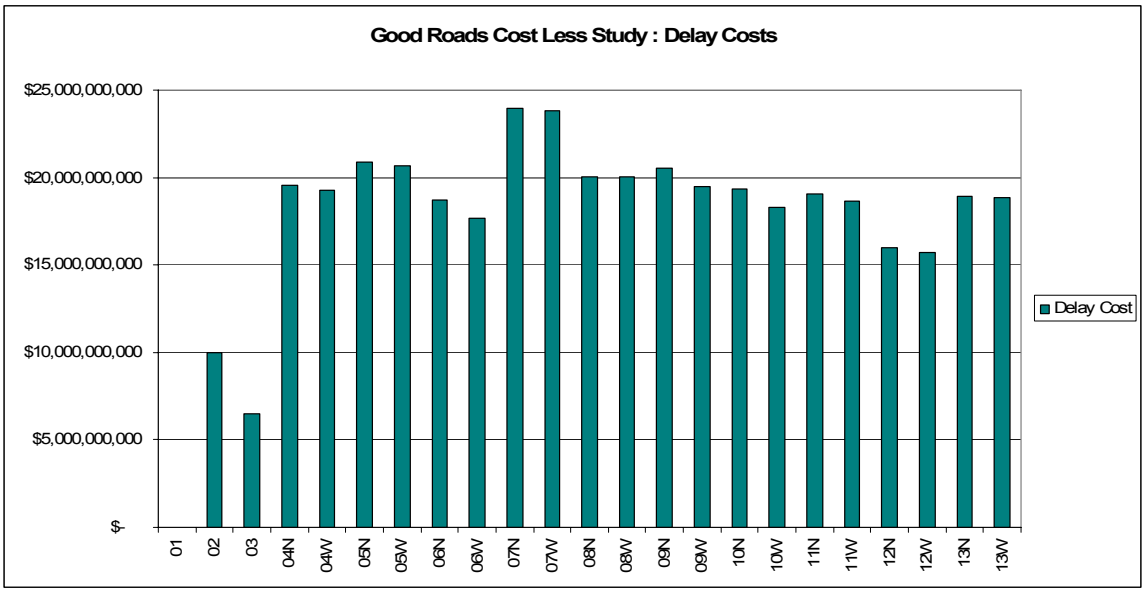

Figure 7: Delay Costs by Strategy

As can be seen in the results, the mix of minor maintenance and rehabilitation treatments has a slight impact on the Delay Costs as the minor treatments can be done without causing a great deal of delay. The strategies where the Blue book program expenditure far outweighs the Orange book program expenditure, the delay costs are slightly higher.

As you may remember from the individual strategy results, Strategy 7 sets the timing cycle to 8 years and 10 years and within this strategy approximately half of all the treatments completed within the analysis period are Minor Rehabilitation treatments which leads to an increase in delay costs which are higher than any other strategy. The miles of each treatment for each strategy are displayed in Table 5 as follows:

Strategy	Chip Seal	Functional Repair	Grind	Major Rehab Asp	Minor Rehab Asp	Minor Rehab Con	OG Seal	Prev Mtce Con	Recon Asp	Recon Conc	Total
01	0	0	0	0	0	0	0	0	0	0	0
02	1861	11990	677	0	0	0	311	193	0	0	15032
03	0	0	0	0	0	0	0	0	506	264	770
04N	3558	771	147	455	8276	638	358	79	119	121	14523
04W	3886	1474	193	235	6706	622	363	89	79	74	13721
05N	7636	1024	130	552	6002	723	733	532	143	115	17591
05W	7984	1149	130	380	5608	703	701	600	120	103	17479
06N	7583	949	89	833	5053	701	794	590	161	115	16867
06W	7879	1242	101	690	4690	679	731	657	134	103	16907
07N	3740	1132	138	467	7535	780	437	375	127	103	14834
07W	4370	1557	136	173	6432	808	429	375	96	93	14469
08N	3272	910	89	600	7248	790	426	223	156	115	13829
08W	3987	1588	101	220	5969	738	448	324	121	103	13599
09N	2026	1043	137	497	8053	851	274	56	141	103	13181
09W	2809	1559	159	135	6682	865	317	62	94	81	12762
10N	1617	1355	253	617	8658	558	177	48	52	90	13425
10W	1658	2523	273	382	6511	558	178	34	27	70	12213
11N	435	1928	329	1105	7169	361	93	31	33	108	11593
11W	393	3080	343	620	5669	361	97	6	17	82	10668
12N	1820	1871	280	343	6385	302	180	0	39	69	11289
12W	1978	2248	278	187	5299	304	178	0	20	69	10561
13N	3117	1721	205	308	7246	529	278	38	79	94	13615
13W	3459	1898	220	184	6024	553	311	22	55	69	12796

Table 5: Strategy Treatment Lengths (miles)

1.6.5 Overall System Condition

Figure 8 displays the resulting Overall Condition Index (OCI) in the last year of the analysis along with the total Agency Costs for each strategy.

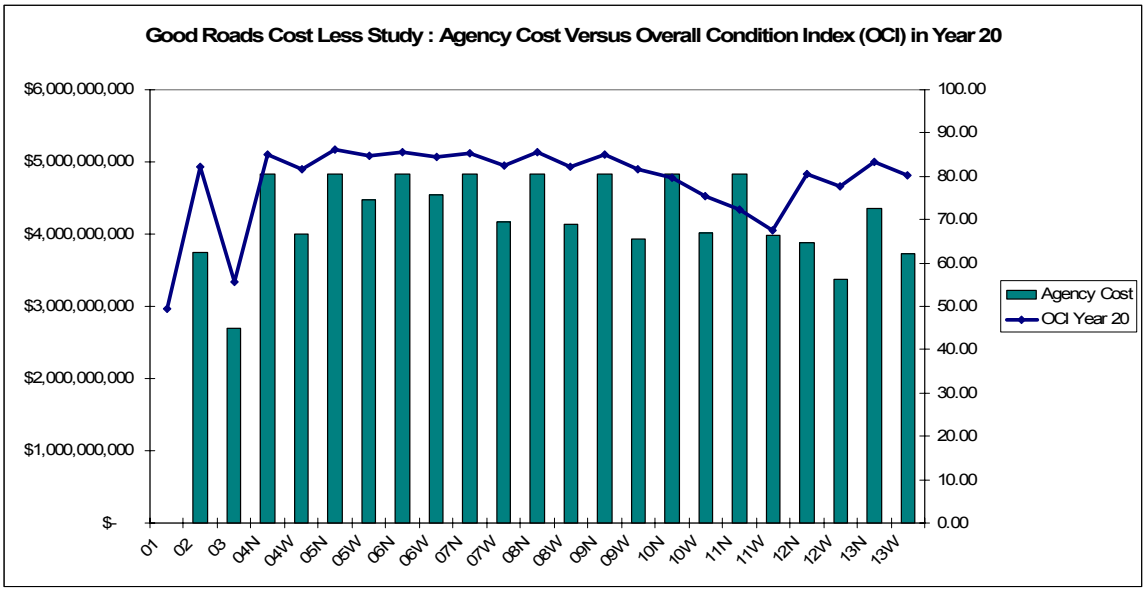

Figure 8: Agency Costs versus Overall Condition Index (OCI)

Strategies where UDOT maintains the current preservation and rehabilitation strategies, the overall network condition is maintained throughout the analysis period. In the strategies where funding is reduced, the network average condition deteriorates substantially which leads to a tremendous backlog of roads needing major rehabilitation improvements.

1.6.6 The Ride Index

Figure 9 displays the resulting Ride Index in the last year of the analysis along with the total Agency Costs for each strategy.

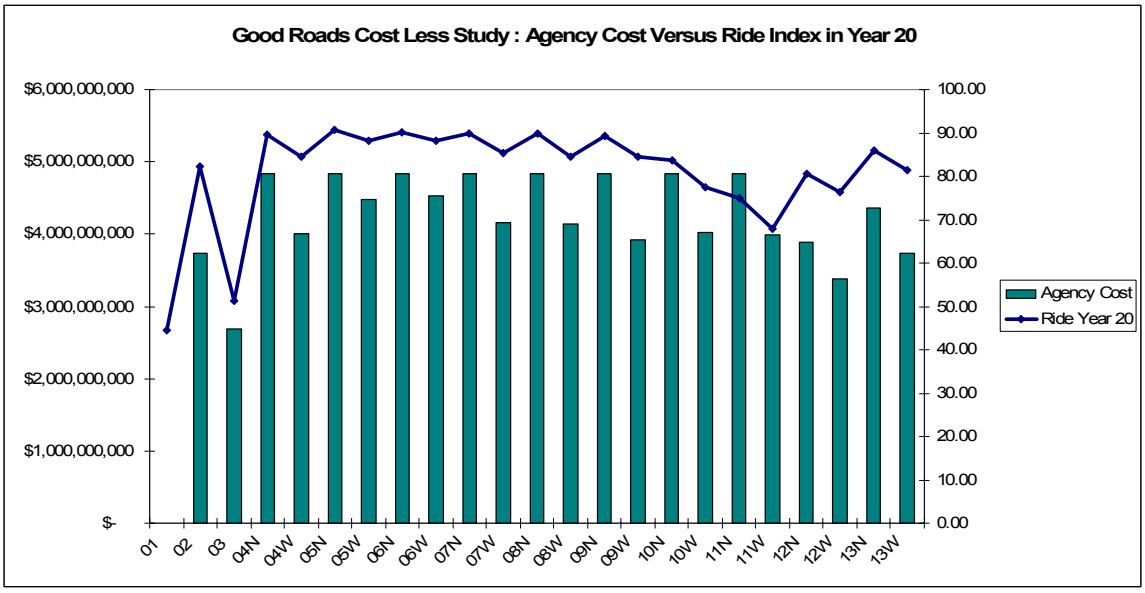

Figure 9: Agency Costs versus Ride Index

As was seen with the OCI, strategies where UDOT maintains current preservations and rehabilitation policy maintains the Ride Index at excellent level.

1.6.7 The Remaining Service Life Index

Figure 10 displays the resulting Remaining Service Life Index (RSL) in the last year of the analysis along with the total Agency Costs for each strategy.

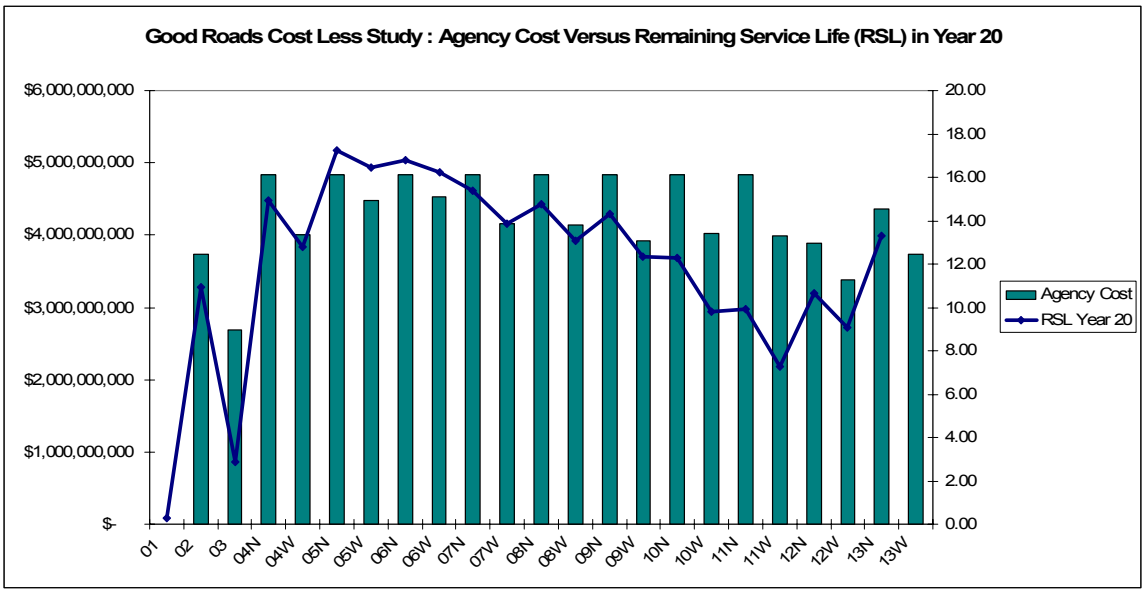

Figure 10: Agency Costs versus Remaining Service Life (RSL)

There is a noticeable difference in the RSL between the various strategies but those strategies that see UDOT maintaining current preservation and rehabilitation funding maintain the network RSL throughout the analysis period. Strategies where funding is significantly reduced creates a large backlog of pavement sections requiring major rehabilitation.

1.7 The Good Roads Cost Less Study Conclusions

Various strategies within the study show that a deterioration of the Utah highway network condition by amounts of 5%, 10%, and 20% would lead to an increase in user costs, accident costs and an increase in necessary funding to bring the system condition back current system condition levels.

Various strategies also indicate that current UDOT funding is adequate to maintain the highway system in its current condition but not sufficient to increase the system condition if any deterioration of more than 5% occurs.

This study has shown that a poor highway network impacts the economy and the citizens of Utah through increased accident costs, user costs, agency costs and delay costs as larger rehabilitation treatments are needed to restore the highway network to a good condition. Maintaining the network in good condition helps to reduce the impacts to the Citizens of Utah.

Good roads do indeed cost less and as stewards of the public infrastructure, UDOT must maintain the highway network in good condition to minimize the impacts on the citizens of the state.

If UDOT did maintain the condition of the highway network at a lower overall OCI with significantly less expenditure over the analysis period an increase in accident costs and user costs would occur and the overall structural health of the network would suffer.

The strategies in the study allowed the resulting average condition of the network to vary greatly from highs of 85 OCI to lows of 50 OCI with expenditures ranging from a high of $4.8 billion to a low of $2.6 billion for the reconstruction only strategy.

If UDOT were to allow the system to deteriorate to a value of 50 over the analysis period, the difference in costs between the two levels of condition would be approximately $2.2 billion which is only 13% of the $16.5 billion of the unmet highway needs outlined in the Utah Transportation 2030 Long Range Plan. After that 20 year period was completed, UDOT's rehabilitation needs would continue to grow substantially as the network deteriorated into poorer and poorer condition.

The recommendation of this updated Good Roads Cost Less study is similar to the recommendation of the Good Roads Cost Less study in 1977. UDOT must strive to

maintain the highway pavement assets in as good a condition as possible to minimize the impacts of the network to the citizens of Utah.

The preservation and rehabilitation dollars that could be diverted away from the program to fund capacity improvements would not be significant to impact capacity throughout the UDOT network. But that diversion of funds would have a significant impact on the highway network condition and its maintenance and rehabilitation needs in the future and on the user costs, accident costs and delay costs for the citizens of Utah. Clearly, Good Roads Do Indeed Cost Less.

This conclusion and confirmation that Good Roads Cost Less is based upon the findings of the study and are summarized as follows:

- Pavements that are in good condition today can be maintained by an appropriate mix of minor maintenance, preservation and rehabilitation treatments that maximize the network OCI and prolong the life of the pavements.

- Pavements that are left to deteriorate to poor and very poor condition cause significant increases in accident costs, user costs, agency costs and delay costs.

- Pavements that are allowed to deteriorate to poor and very poor condition cannot be maintained through minor maintenance treatments as the treatment trigger mechanisms prevent inappropriate treatments taking place on pavements whose condition warrants a more extensive and expensive rehabilitation treatment.

- Pavements that deteriorate enough to bring the overall condition of the network lower by 20% or even by 10% can cause a funding crisis as the need for more expensive rehabilitation treatments raise the agency costs to the point where alternative funding solutions would be necessary.

- Current UDOT funding is sufficient to maintain the UDOT network in good condition but would be insufficient to restore the UDOT network to a good condition if the overall condition of the UDOT network were to deteriorate by as little as 10%.

- Diverting maintenance and rehabilitation dollars to support capacity enhancements (or other facilities or programs) will cause a deterioration of the road network overall condition throughout the analysis and would require a larger influx of money after the initial transfer of funds to restore the network to its current condition.

- When budget categories were used within the analysis, the resulting condition of the network was lower than the resulting condition when no budget categories were used even if no other parameters were changed. This leads to the recommendation that UDOT strive towards being more flexible in determining the funding for minor maintenance and rehabilitation treatments no matter the source of the funds.

Upon completion of this study, UDOT will investigate the performance goals for each of the systems (Interstate, Arterial, Collector and Network Wide) and present those goals to the Utah Transportation Commission for approval.

2. References

[1] Bureau of Transportation Statistics, The Intermodal Transportation Database, Time Series Analysis - Grand Total: Vehicle(Million) Miles Traveled, Electronic Database at http://www.transtats.bts.gov

[2] 2005 Annual Statistical Summary, UDOT Systems Planning and Programming, Electronic Report at www.udot.utah.gov